1. If I wish to obtain a reasonable estimation of the mean values of $y(t) = A\sin(2\pi t) + 8\cos(24\pi t)$ how many samples should I acquire if my sampling rate is 100 samples per second?
   a. 24 samples
   b. 50 samples
   c. 24π samples
   d. 1000 samples

2. If I have a thermal couple with a 1 mV per degree Celsius sensitivity it will response slower to a temperature change than one with a 10 mV per degree Celsius sensitivity.
   a. True
   b. False
   c. Unknown

3. A output of a first order sensor, like a thermal couple, will ALWAYS lag the input signal.
   a. True
   b. False

4. A first order sensor with a large time constant, τ, will attenuate high frequency input signal less than one with a small time constant.
   a. True
   b. False

5. The ADC used in our lab has what type of architecture?
   a. Flash
   b. Pipelined
   c. Successive approximation
   d. Sigma-delta

A temperature sensor is to be selected to measure the fluctuating temperature within a cylinder of an internal combustion engine. It is suspected that the temperature will behave as a periodic waveform with a frequency around 180 radians/second. (Rotating at 1800 rpm). Several size sensors are available, each with a known time constant.

6. What percent reduction in output/input signal magnitude would you expect at the 1800 cycle/minute frequency from a thermocouple with a 1/9 of a second time constant? (assume $\pi = 3$ and static sensitivity, K=1)
   a. 5%
   b. 30%
   c. 70%
   d. 95%
   e. None of the above

7. If you were required to maintain a dynamic error of less than 29.3% ($M(\omega) \geq 70.7\% = 1/\sqrt{2}$) for the internal combustion engine temperature measurement described above what would be an acceptable thermocouple time constant?
   a. 1/180 seconds
   b. 1/90 seconds
   c. 1/60 seconds
   d. 1/30 seconds
   e. None of the above
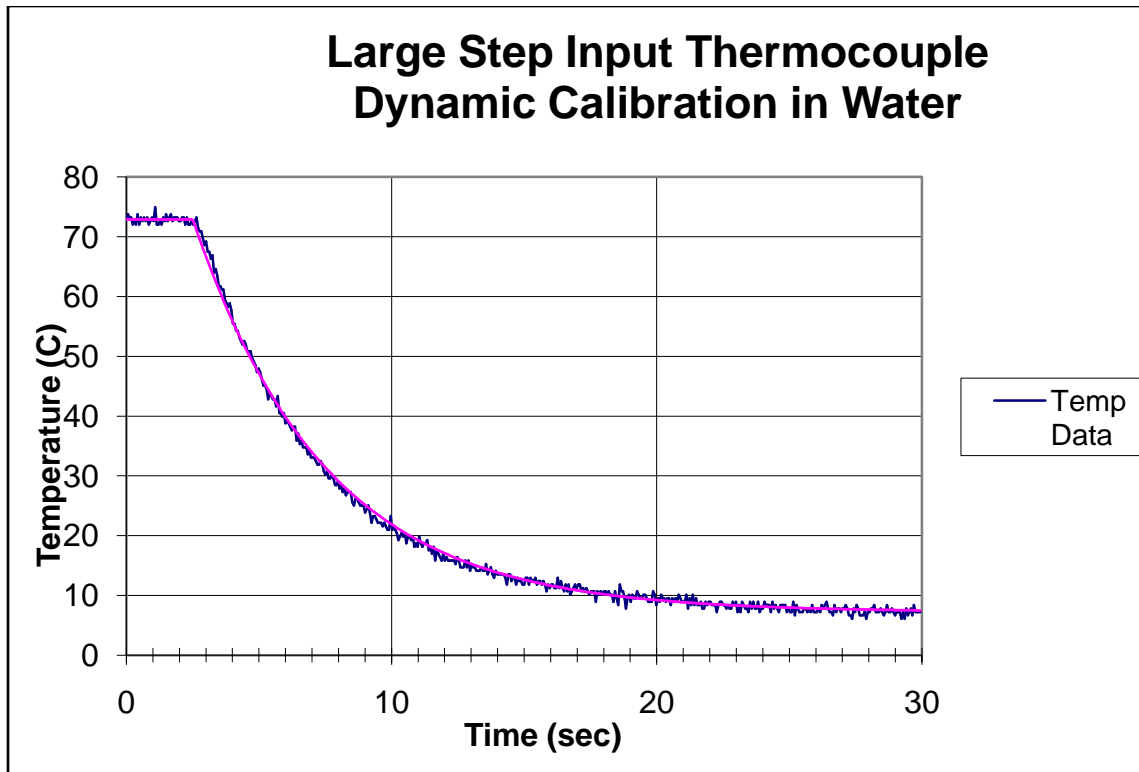
Figure 1. Data set from Lab 2 dynamic calibration.

8. The approximate time constant, τ, of the thermocouple response plotted in Figure 1 is:
    a. 2 seconds
    b. 5 seconds
    c. 7 seconds
    d. 10 seconds
    e. 23 seconds

9. If a thermocouple is more sensitive (the static sensitivity is larger) the dynamic response would be faster (the time constant would be smaller).
    a. True
    b. False